

Transitioning Human, Social, Cultural Behavior (HSCB) Models and Simulations to the Operational User¹

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ABSTRACT

One of the major challenges facing the Modeling & Simulation (M&S) community is successfully transitioning human, social, cultural behavior (HSCB) M&S to the operational user. To achieve that objective, this paper presents a framework to characterize HSCB needs and gaps. The framework subsumes contributions from operations analysts (e.g., representation in tools; tools; explorations of “possibility space”; design of experiments), social scientists (e.g., basic research; measures of merit; social science theories), and key stakeholders including operational users (e.g., definitions; data; verification, validation and accreditation (VV&A); education and training; and outreach). For each of these areas the paper identifies key needs to facilitate the transition of HSCB M&S to the operational user. Furthermore, based on the current state of the practice, the paper identifies key gaps in each of these twelve areas.

Subsequently, the paper identifies key time-phased steps to enhance the transitioning of existing HSCB M&S to the operational users. The emphasis is on actions to correct shortfalls in existing Doctrine, Organization, Training, Materiel, Leadership & Education, Personnel, and Facility (DOTMLPF) factors.

The paper concludes by identifying key steps that should be taken to enhance the transition of HSCB products to the operational user. They include the need to develop a lexicon; sustain a community of interest/community of practice; evolve a methodology for operational users; evolve an HSCB data repository; enhance the education and training of all stakeholders; refine HSCB requirements; and employ an evolutionary acquisition process to develop an operational testbed.

I. INTRODUCTION

This paper documents the challenges in transitioning Human, Social, Cultural Behavior (HSCB) Models and Simulations (M&S) to the operational user.

The paper consists of four additional sections. As background, the next section provides context for the paper, identifies the paper’s goal and objectives, and briefly discusses the approach that was taken.

The next section provides insights on the nature of the problem. It decomposes the problem into its component parts and provides selected observations and needs. A more complete characterization of observations and needs is provided in Appendix A.

¹ Disclaimer: The views expressed in this article are those of the authors and do not reflect the official policy or position of the National Defense University, the Department of Defense or the U.S. Government. All information and sources for this paper were drawn from unclassified materials.

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The following section provides selected findings and recommendations that emerged from selected Combatant Command (COCOM) panels. It characterizes the key shortfalls in key areas, identifies areas that warrant research, and identifies actions to correct existing shortfalls in existing Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF).

The final section identifies key steps that should be taken to enhance the transition of HSCB products to the operational user. They include the need to develop a lexicon; sustain a Community of Interest/Community of Practice (COI/COP); evolve a methodology for operational users; evolve an HSCB data repository; enhance the education and training of all stakeholders; refine HSCB requirements; and employ an evolutionary acquisition process to develop an operational testbed.

II. BACKGROUND

Important context for this paper was established at FOCUS 2010. The meeting was convened at the Westfields Conference Center, Chantilly, VA, August 5 – 7, 2009. At that conference, approximately 150 papers were presented on HSCB products. These papers were divided into eleven tracks that ranged from human behavior to transitioning to the operational user.

In one of the keynote addresses, Dr. Bob Foster, Director, BioSystems Research Directorate, OSD, DDRR&E, observed that “Transition is key – who’s going to use this tool you’re building?”

Consistent with that question, the goal of this paper is to identify the steps that should be taken to transition HSCB products to the operational user. Consistent with that goal, five specific objectives will be addressed in this paper.

First, steps need to be taken to create a Community of Interest/Practice (COI/COP) (e.g., government, academia, FFRDC, industry) that is more knowledgeable about the COCOMs planning process. Second, there is a need to determine what capability requirements for HSCB tools are needed to address the HSCB challenges confronting COCOM decision-makers and analysts in planning, assessing, analyzing, and executing campaign plans. Third, it is important to identify current COCOM methods, tools, data, intellectual capital, and processes to address these capability requirements. Fourth, there is a need to compare capability requirements to current capabilities to identify gaps that may be addressed with DoD HSCB methods, tools, data, intellectual capital, and process development efforts. Finally, it is important to determine what changes in DOTMLPF may be needed to transition HSCB tools, efficiently and effectively, in a sustained manner, to the operational user.

To address this goal and objectives, two workshops were convened at NDU. The first workshop was conducted in June 2008 and charged with identifying broad operational needs (Reference 1). To address that issue, approximately 120 operational analysts and social scientists were assembled. That group explored the problem from a disciplinary perspective (e.g., macro- and micro-social scientists and operations analysts) and a cross-disciplinary perspective (e.g., focusing on the issues of deterrence; counter-insurgency; counter-terrorism; and security, stability, transition, and reconstruction (SSTR) operations). Based on these deliberations, the issue was parsed and key observations and needs were identified (see below).

Subsequently, a second meeting was convened at NDU in June 2009 to facilitate the transition of HSCB products to the COCOMs (Reference 2). That meeting was organized around four COCOM teams: AFRICOM, EUCOM, PACOM, and SOUTHCOM. Each of these teams also had representatives from CENTCOM and SOCOM, as well as operational analysts and social scientists. The results of these deliberations are discussed below.

III. INSIGHTS ON THE NATURE OF THE PROBLEM

This section provides insights on the nature of the problem. It decomposes the problem into its component parts and provides selected observations and needs for the HSCB data problem.

In the June 2009 NDU workshop, the findings and recommendations from the initial HSCB workshop were summarized. Consistent with the findings of Workshop I, Workshop II elected to decompose the HSCB modeling problem into 12 key sub-areas (see Figure 1). For each of those sub-areas key shortfalls were identified and preliminary needs were identified to address those shortfalls.

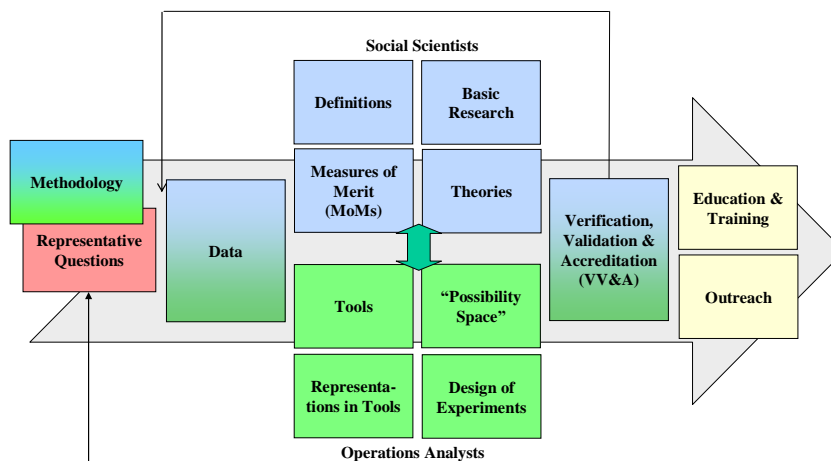


Figure 1. Capabilities Needed for HSCB Modeling

HSCB modeling needs were classified into twelve interrelated categories. As noted in the above figure, the driver for the needs arises from the representative questions from operational users and senior decision makers. There are four key categories where the needs transcend disciplinary needs: data, verification, validation, and accreditation (VV&A), education and training, and outreach. Four categories are of particular concern to the social sciences: definitions, basic research, Measures of Merit (MoMs), and theories. Four categories are of particular concern to operations analysts: tools, representation in tools, explorations of “possibility space”, and design of experiments.

To illustrate the insights that were derived from workshop I, the following discussion addresses key HSCB data needs. The associated observations and needs for the other areas are summarized in Appendix A.

The workshop participants identified three basic data issues. First, they observed that existing HSCB data sets are diffused, difficult to find and access. Second, the data lack the necessary information to support analysis (e.g., adequate metadata, indications of pedigree). Finally, they observed that data are rarely ready for use; they require clean up, conversion to fit current needs.

To address these issues, the workshop participants identified six key themes for data needs. First, there is a need to develop appropriate HSCB taxonomies and ontologies. Second, it was observed that there is a need to implement efforts to *tailor* HSCB data to satisfy the intended purposes. Third, it is important to perform and record data V&V efforts (e.g., integrity, consistency, reliability, source) as metadata. Fourth,

it is vital to avoid “stale” data. Thus, there is a need to update local and national data, with appropriate periodicity. Fifth, the complexity of the questions requires that we capture data capabilities in many dimensions. As a partial listing, we need data in the areas of the environment, medical, attitudes, affiliations, and legal systems. Finally, given the dispersion of the data, it was recommended that we perform an assessment of the desirability of a Central HSCB Data Repository. That study should address a variety of issues including classification, access, open source data, legal, granularity, qualitative data, maintenance, and dissemination.

IV FINDINGS AND RECOMMENDATIONS

The following section provides selected findings and recommendations that emerged from the COCOM panels in workshop II. It characterizes the key shortfalls in key areas, identifies areas that warrant research, and identifies actions to correct shortfalls in existing DOTMLPF factors.

Each of the panels used “stop light” charts to evaluate the “As Is” HSCB process. Table 1 was generated by assigning numerical values to each of the “stop light” colors (as documented in the legend) and averaging across them. As can be seen in the table, there was broad agreement that the key factors (i.e., tools, data, methodology, Measures of Merit, and Intellectual Capital) range from major shortfalls (e.g., tools) to significant problems (e.g., intellectual capital). It was noted that most of the panels regarded the challenge of VV&A as a responsibility of others. However, since the COCOM decision maker is responsible for accrediting key results, a significant role in VV&A should be played by the operational user and the decision maker.

Factor	Assessment*
Tools	1.2
Data	1.8
Methodology	2.2
Measures of Merit	2.2
Intellectual Capital	2.6
VV&A	N/A

*Legend: R=1; A/R=2; A=3; A/G=4; G=5

Table 1. Assessment of HSCB “As Is” Process

In the area of basic research, two key areas were identified by the AFRICOM panel. First, they noted that they faced considerable challenges in the area of data (e.g., they lack access; the academic community is not familiar with the DoD requirements). In addition, there are major problems in the area of Intellectual Capital (e.g., it is not clear how subject matter experts (SMEs) are identified, vetted, selected, and used). The PACOM panel also identified data research issues (e.g., weighting of qualitative information).

However, the PACOM panel also noted shortfalls in social science theories (e.g., organizational affinity/loyalty; violent predispositions).

In the area of applied research, the AFRICOM panel called out challenges in tools (e.g., how generalizable is it?), education and training (e.g., need greater relevance to the military context), data, and VV&A (e.g., tests and exercises have already been done to judge the utility of models, but these results are not transparent). However, the PACOM panel cited the need for enhanced data (e.g., data dictionary, lexicon; design of a common data base and data repository) and VV&A.

Clearly, additional work is needed to fully articulate the research interests of the COCOMs and to prioritize them.

Overall, the AFRICOM, EUCOM, PACOM, and SOUTHCOM panels formulated several major recommendations to enhance significant shortfalls in existing DOTMLPF factors.

In the area of doctrine, there was broad support to develop a Whole of Government plan for HSCB. One aspect of this plan would be to share HSCB information effectively with the Interagency. In addition, there was interest in enhancing the community's interactions with social scientists.

In the area of organization, there was broad agreement that the COCOMs lack the organic intellectual capital needed to deal with HSCB issues. Consequently, there was a consensus to enhance the COCOM's reach-back capability. Furthermore, organizational change was required to reduce the "seams" that exist with HSCB factors (e.g., DoD-Interagency)

Many of the panels placed extremely high emphasis on the challenge of HSCB education and training. For example, it was stressed that it was vital to enhance education in the areas of culture, language, and religion. Furthermore, it was recognized that military personnel are ill-prepared to perform HSCB analysis. Thus, high priority should be given to addressing the education and training needs of military personnel for HSCB analysis prior to arriving in the theater.

In the area of materiel, it was broadly recognized that we lack the tools necessary to support HSCB analysis. It was recommended that we enhance key tools by enhancing the collection of data, analyzing social networks, and enumerating the evolving capability to support HSCB analysis. In addition, there was strong agreement that we needed to improve visualization tools.

In the area of leadership it was understood that we need HSCB "champions". Consequently, it was important to educate leaders with respect to HSCB. In addition, several panels emphasized the importance of developing social science skills.

In the area of personnel each of the panels stressed the importance of developing HSCB SMEs. In addition, to provide continuity in HSCB analysis, several panels cited the need to create a disciplined career path.

Finally, in the area of facilities, several panels suggested that it would be useful to establish Centers of Excellence for HSCB. In addition, since several of the evolving tools make substantial demands on computational support, facilities should be created to satisfy that need.

V. KEY NEXT STEPS

The final section of this paper identifies key steps that should be taken to enhance the transition of HSCB products to the operational user. They include the need to develop a lexicon; sustain a COI/COP; evolve a methodology for operational users; evolve an HSCB data repository; enhance the education and training of

all stakeholders; refine HSCB requirements; and employ an evolutionary acquisition process to develop an operational testbed.

1. Lexicon

It is clear that it is difficult for the operational and HSCB communities to communicate. There are three major reasons. First, both communities speak in (non-intersecting) “acronymese” and jargon. For example, during one of the working groups, one of the social scientists asked the meaning of the abbreviation “ISR” (i.e., “Intelligence, Surveillance, and Reconnaissance”). Furthermore, most of the social science participants lacked familiarity with major DoD products (e.g., the 2006 Quadrennial Defense Review (Reference 3); DoD directives (Reference 4)). Overall, there is a need for “semantic interoperability”! However, it may be more feasible to develop a “Rosetta Stone” that translates jargon across the various communities. Note that NATO Studies Analysis and Studies (SAS)-071 identified this as an issue that should be resolved (Reference 5).

2. COI/COP

The NDU workshops served to bring together the key stakeholders in the process (e.g., operational users, social scientists, computational social scientists, operations analysts). In general, the foundation for a “two-way” dialogue was established. The HSCB participants achieved a deeper understanding of the COCOM planning process and the COCOM participants were exposed to the “state of the art” in HSCB thinking. However, this is just the start of the process. All the stakeholders in the process will require enhanced interaction if inter-disciplinary teams are to emerge that manifest trust and confidence.

3. Methodology

There is no agreement on the methodology that COCOMs might employ to support operational planning needs. As one possibility, The TRADOC Analysis Center (TRAC) is pursuing an Irregular Warfare Campaign that envisions interaction among wargames (e.g., son-of-Peace Support Operations Model (PSOM)) and selected M&S (e.g., adjudication using TRAC-Monterey’s Cultural Geography Model in conjunction with the Simulations, Experiments, and Efficient Design (SEED) Center’s Design of Experiments). This initiative should be evaluated for “lessons recorded”. Note that this approach was recommended at the Military Operations Research Society (MORS) workshop on Irregular Warfare that was convened at the Naval Postgraduate School (NPS) in December 2007 (Reference 6).

4. Data

The HSCB data problem is extremely challenging. As noted above, there are many issues that must be overcome if timely, complete, usable data are to be available to the key stakeholders. Figure 2 suggests some of the challenges that confront the HSCB community.



5. Education and Training (E&T)

6. Requirements

However, it is necessary to refine those requirements through a survey and interviews with operational users. Thus, a survey is envisioned that will begin with the needs identified at the NDU workshops and elicit operational user inputs (e.g., validate; modify; augment; subtract). That survey will be followed up with in-depth interviews with the key stakeholders.

7. Operational Testbed

The operational users have expressed an interest in an operational testbed in which they can get introduced to HSB products, receive E&T for key HSCB products, and understand the evolving process (e.g., use of reach-back).

Figure 3 graphically depicts the key features of the evolutionary acquisition approach to transitioning HSCB insights to the operational user. It can be seen that the process begins with an understanding of the nature of the problem and an associated needs analysis. This leads to the creation of an open framework that is created in the anticipation of future evolution. The intent is to field a core capability as soon as possible to begin to satisfy the operational user's basic needs. Subsequently, the objective is to augment the core, periodically, with increments that reflect operational lessons learned from the user's experience and that reflect technology advances in our understanding of HSCB issues. Note that this process should be able to generate a mix of tools and data which may not need to be electronically linked.

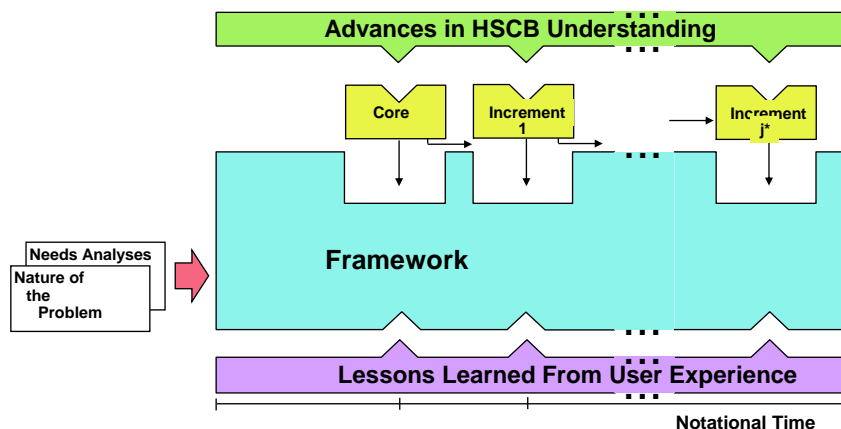


Figure 3. Adopt an Evolutionary Acquisition Approach for an Operational HSCB Modeling Testbed

8. Summary

The challenge of transitioning HSCB products to the operational user is a difficult one. As discussed in this paper, it will require at least seven, inter-related activities. These include developing a lexicon to enhance multidisciplinary communication; sustaining a COI/COP; evolving a methodology that can be employed by operational users; evolving an HSCB data repository; enhancing the education and training of all stakeholders; refining HSCB requirements; and employing an evolutionary acquisition process to develop an operational testbed. In the near-term, a series of workshops and initiatives are planned to address each of these challenges.

APPENDIX A. NEEDS IDENTIFIED AT THE HSCB MODELING WORKSHOP

Introduction. During the course of the first NDU Workshop on HSCB modeling, key needs were identified in twelve interrelated areas (see Figure 1). These needs arose from the canonical questions that are posed by operational users and senior decision makers. This appendix briefly identifies the types of questions that are posed to the HSCB modeling community. That is followed by a brief statement of the needs that emerged for the twelve areas of interest.

Questions. Many of the questions from operational users and senior decision makers can be assigned to five areas. First, there is interest in **predicting** a future state. For example, there may be interest in predicting refugee flows, contagion of disease, or authenticity of cultural change. Second, there is interest in **supporting an activity**. As an example, analysts are frequently asked to support the generation of Theater Security Cooperation Plans (TSCPs). Third, there is often the need to **balance competing activities**. For example, a request may be made to balance flow through the SSSTR process (e.g., characterize which activity should be done, when). Fourth, there is interest in **prioritizing** among competing options. This can range between investing resources (e.g., among S&T options) to support to operations (e.g., which SSSTR operations to undertake). Finally, there is pervasive interest to **understand** the context or root causes. For example, there is interest in understanding, *inter alia*, failed states, legitimacy, why people become insurgents, deterrence/influence /containment, unintended consequences, and governance. Consistent with these questions, the participants at the workshop identified the following HSCB modeling needs.

Data Needs. As noted above, the workshop participants identified six key themes for data needs. First, there is a need to develop appropriate HSCB taxonomies and ontologies. Second, it was observed that there is a need to implement efforts to *tailor* HSCB data to satisfy the intended purposes. Third, it is important to perform and record data V&V efforts (e.g., integrity, consistency, reliability, source) as metadata. Fourth, it is vital to avoid “stale” data. Thus, there is a need to update local and national data, with appropriate periodicity. Fifth, the complexity of the questions requires that we capture data capabilities in many dimensions. As a partial listing, we need data in the areas of the environment, medical, attitudes, affiliations, and legal systems. Finally, given the dispersion of the data, it was recommended that we perform an assessment of the desirability of a Central HSCB Data Repository. That study should address a variety of issues including classification, access, open source data, legal, granularity, qualitative data, maintenance, and dissemination.

Definition Needs. At the workshop, it was noted that for HSCB modeling the social scientists needed to develop more specific definitions and define commonalities across disciplines to drive action. Specifically, there is a need to develop a variety of products including, *inter alia*, a library of ontologies, semantic descriptions, a thesaurus, a dictionary, data lexicons with metadata, and standards. Many of these needs overlap with the data needs, cited above.

Measures of Merit (MoMs) Needs. Historically, the operations research community has been comfortable with the concept of formulating MoMs subsuming Measures of Performance (MoPs) and Measures of Effectiveness (MoEs). However, practitioners of the social sciences are less familiar with this approach. Thus, we need to tailor the MoMs to HSCB problems of interest and develop relationships that link key MoPs and MoEs. Furthermore, we need to display HSCB MoMs to operational users and senior decision makers in a fashion that conveys appropriate levels of uncertainty and risk.

Theory Needs. As demonstrated at the workshops, the social sciences have formulated competing theories for many subjects of interest (e.g., root causes of terrorism). When multiple theories exist, we need codes of best practice/guidelines on which theory to use, when. In addition, there are many areas where the social sciences have not yet developed theories in forms useful for HSCB modeling. We need to develop

appropriate social sciences theories to address these key gaps or mismatches.

Basic Research Needs. There are many areas of interest to national security where basic research in the social sciences must be performed to support HSCB modeling. For example, we need studies of influencers on attitude/behavior of civilians based on ethnic, tribal, cultural, religious, and political considerations. It is important to develop a comprehensive list of these areas where basic social science research is needed and to prioritize this list from a national security perspective.

Tools Needs. There was broad agreement at the workshop that we require an expanded set of HSCB tools. However, the proper architecture/framework for these HSCB tools is an open question. The workshop did, however, elicit the following needs with respect to tools: the suite of tools should include a balanced mix of techniques that take advantage of the strengths of the tools while ameliorating their weaknesses (e.g., system dynamic models; agent based models; wargames); consideration should be given to creating a “collaborative environment” in which selected models can be linked/federated and evaluated (particularly with respect to “precision”); consider the use of a “service bus” or Global Information Grid for data repositories; ensure that models are tailorable; employ hierarchical modeling with meta-model/meta-data aggregation/disaggregation; and assemble a resource repository of models and data.

Representations in Tools Needs. The question in this area is what real-world factors should the tools represent? The participants at the workshop warned against “mirror-imaging”. Thus, it is important that we use creativity in modeling ourselves as well as “others”. In addition, the workshop subdivided the social scientists into the categories of “micro” and “macro” representations. This is an artificial distinction and we need to provide feedback between “micro” and “macro” representations. Overall, there is a need to capture phenomena from multiple perspectives. These include organizational performance, cultures and institutions, all types of operations, and situational awareness of all parties.

“Possibility Space” Exploration Needs. Above, we cited representative questions that might be posed by the operational users and senior decision makers. It is important to clarify the extent to which we can perform HSCB modeling to “predict” outcomes. As an example, at least four possible levels of prediction are envisioned. These include: “hard” predictions of events (with “error bars” to characterize uncertainty); “soft” predictions of likelihoods (e.g., for multiple possible results); explorations of possibilities (e.g., “what if...?”); or situational awareness and understanding.

Design of Experiments Needs. It was clear from the workshop presentations that many of the users of HSCB models were not familiar with efficient, effective designs of experiments. We should draw on the insights developed in academia (e.g., at NPS for M&S characterized by large numbers of variables) to characterize the interesting parts of response surfaces using innovative experimental designs (e.g., focused fractional factorial designs). In addition, due to the uncertainties associated with HSCB models, consideration should be given to exploratory analyses to more fully capture the response surfaces of those models over a broad range of assumptions.

Verification, Validation & Accreditation (VV&A) Needs. One of the key themes of the workshop was the need to perform VV&A for HSCB models. To achieve that objective, there is a need to generate guidelines that enable us to perform V&V credibly, with acceptable levels of resources. Historically, the operations research community has focused on V&V of models and data. However, the workshop emphasized that the social sciences pose additional challenges in order to V&V relevant theories and SMEs. Note that the V&V process must be documented, transparently, to facilitate implementation of the accreditation function. In addition, the working group on VV&A recommended that we use V&V to create “tags” for theories, methods, models, and data to allow retrieval of desired items when needed. Furthermore, there is a need to create open data on the detailed VV&A status of models and data.

Education and Training (E&T) Needs. Four E&T needs emerged from the workshop. First, there is a

need to augment the curriculum for social scientists and operations analysts to give them adequate education to enhance cross-discipline communication. Second, it is vital to create and sustain a HSCB COI/COP to foster high performance, multidisciplinary teams. This COI/COP should provide continuity of action using a variety of approaches (e.g., electronic interaction; face-to-face meetings). This continuity might be achieved by drawing on MORS' proposed Social Science COI/COP. Third, there is a need to educate senior decision makers about our current and projected capability to perform HSCB modeling. At a minimum, there is a need to develop a "check list" that will enable senior decision makers to better pose the key questions that they pose to the analysis community. Lastly, there is a need to develop the tools and data needed to "train as we fight" to support both the E&T and operational communities.

Outreach Needs. The workshop highlighted three areas where enhanced HSCB modeling outreach is needed. First, it is vital to expand the HSCB COI/COP to include balanced interagency participants (e.g., National Security Council, US Institute of Peace, Department of State, Department of Justice). Second, there is a need to participate actively in international forums that address HSCB modeling issues. These would include NATO SAS initiatives on HSCB and Irregular Warfare. Finally, there is great sensitivity to the attitudes of many members of the social sciences community who believe that it would be unethical to work with the DoD. To address that issue, it is important to develop a compelling narrative to explain the value of a collaborative relationship between the social sciences community and DoD.

APPENDIX B. ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	Meaning
AFPAK	Afghanistan-Pakistan
AFRICOM	Africa Command
COCOM	Combatant Command
COI/COP	Community of Interest/Community of Practice
CENTCOM	Central Command
COTS	Commercial-off-the-Shelf
DDR&E	Director, Defense Research & Engineering
DoD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership & Education, Personnel, Facilities
E&T	Education & Training
EUCOM	European Command
FFRDC	Federally Funded Research & Development Center
HSCB	Human, Social, Cultural Behavior
M&S	Modeling and Simulation
MoE	Measure of Effectiveness
MoM	Measure of Merit
MoP	Measure of Performance
NDU	National Defense University
OSD	Office of the Secretary of Defense
PACOM	Pacific Command
PSOM	Peace Support Operations Model
SAS	Systems Analysis & Studies
SEED	Simulations, Experiments, & Efficient Design
SME	Subject Matter Expert
SOCOM	Special Operations Command

SOUTHCOM	Southern Command
SSTR	Stability, Security, Transition, and Reconstruction
TRADOC	Training and Doctrine Command
TRAC	TRADOC Analysis Center
TSCP	Theater Security Cooperation Plan
V&V	Verification & Validation
VV&A	Verification, Validation, and Accreditation

APPENDIX C. REFERENCES

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